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Results of application of a rubric for the evaluation by competences: Measurement of the magnetic field of small magnets with a smartphone

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Abstract

The last year, at the International Conference on Technology, Education and Development (INTED 2018), we presented a paper about a rubric for the development of a physics laboratory practice, for the degree in Computer Engineering, entitled: Elaboration of rubrics for the evaluation by competences of Physics in the University. This task is in the process of being implemented during the academic course 2018/2019, to know if the use of rubrics facilitates and benefits the evaluation process by competences, students and professors.

In this publication, we present the results of a comparative analysis that we have carried out with two study groups; the first group developed the practice with the help of the rubric (experimental group) and the second group, also developed the practice but without rubric (control group).

Through this work, we want to know the impact of the use of rubrics on subjects that are complex for students. As we well know, Physics is different from other subjects, because, most of the time, the answers to the questions we can do to ourselves are not found in books, but they are accomplished through reasoning and inferences, which become sometimes laborious.

We believe that providing a detailed instrument, such as the rubric, where the student is clearly specified what should be developed, facilitate their significant learning.

The use of rubrics is implemented in more theoretical subjects, we know little about their application in sciences, therefore, if our results are positive, we want to continue developing rubrics for future lab work in Physics and share our experience and results with other professors in this area.

This work was applied to students of Physics for Computer Science Engineering of the Faculty of Computer Science Engineering at the University of Castilla -La Mancha (UCLM), Campus of Albacete, Spain.

Keywords: Competence-based approach, rubric, teaching-learning, competence assessment, smartphone.

1 INTRODUCTION

Since the mid-nineties, you can find various interpretations related to the issue of competences, the introduction of the educational model focuses on competences in the different areas of school education, from basic education to higher education [1], [2]. The European Higher Education Area (EHEA) has promoted this educational model based on the development and assessment of professional competences [3] to improve educational quality [4] and as the main paradigm for innovation, both at the system level and at the level of learning environments [5].

Consequently, changes have been experienced in the teaching-learning process, so it has been necessary to modify or elaborate new study program under this novel vision, as well as to propose and implement techniques and instruments that allow its application. Competence education involves combining and integrating knowledge, skills, and attitudes required to fulfill a certain role in a context,

and it is necessary to evaluate competences that must consider important aspects such as context, feedback, and transparency [6].

In this context, this publication aims to present the results of the implementation of a competence assessment tool [7], [8] that has been developed to evaluate a physics laboratory practice [9], for students of Physics for Computer Science Engineering of the Faculty of Computer Science Engineering at the University of Castilla -La Mancha (UCLM), Campus of Albacete, Spain.

We have considered the use of the rubric to evaluate competences. We consider that is an instrument according to a competence vision that benefits both professor and students since we can objectively evaluate the fulfillment of objectives in the different parts of a task, both from the point of view of the academic staff and that of the students [10]. A rubric is an evaluative register that has certain criteria or dimensions to be evaluated and does so by following quality levels or gradations and typifying performance standards [11].

There are two types of rubrics, holistic/global and analytical [7], [8], [11]. The first ones do not separate the parts of the activity to be evaluated, a global description is made without specifying the components of the process, and the second ones clearly detail the indicators of each activity and specify the evaluation criteria according to the level of performance of the student. The rubric to which we refer is analytical, and it has been implemented during the academic year 2018/2019 during the first semester, in the period from September to December 2018.

2 METHODOLOGY

We present the results of the comparative analysis that we have obtained when implementing a rubric for the development of a physics laboratory practice, for the degree in Computer Engineering, entitled: Elaboration of rubrics for the evaluation by competences of Physics in the University [7]. For the implementation of this instrument, we have selected two study groups, a control group and an experimental group. The control group developed the practice without rubric, and the experimental group developed the same practice with the help of a rubric (figure 1a and 1b).

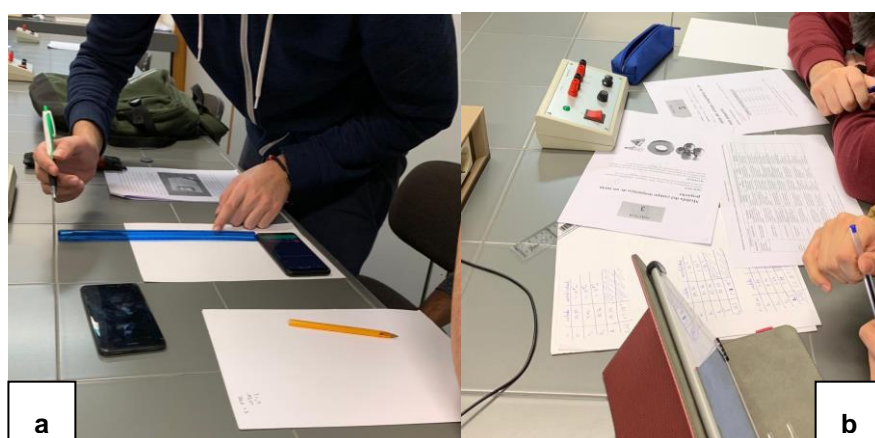


Figure 1. Physics lab session for: a) Control group and b) Experimental group

At the end of the lab session, the responsible professors corrected said practices and assigned the corresponding marks. Later, a survey was applied to the students to know their perception about the usefulness of the use of rubrics in subjects that they consider complicated such as Physics. The perception of the participating professors in this study was also evaluated since they used the rubrics when correcting the practices.

Finally, using the IBM SPSS Statistics 22 software, we carried out the descriptive analysis of the marks obtained, and the results of the perception survey applied to the students of the control and experimental group, as well as the results of the perception survey applied to professors to compare both results.

3 RESULTS

In table 1, we present the descriptive analysis of the marks obtained by the students of the control group and the experimental group.

Table 1. Descriptive analysis of marks.

	Marks of control group	Marks of experimental group
Mean	4.6	5.4
Median	4.5	5
Minimum	1.0	2
Maximum	9.0	10
95 th Percentile	9.0	9.5

In figure 2a y 2b, we show the behavior of the number of students and the marks obtained by the control group and experimental group.

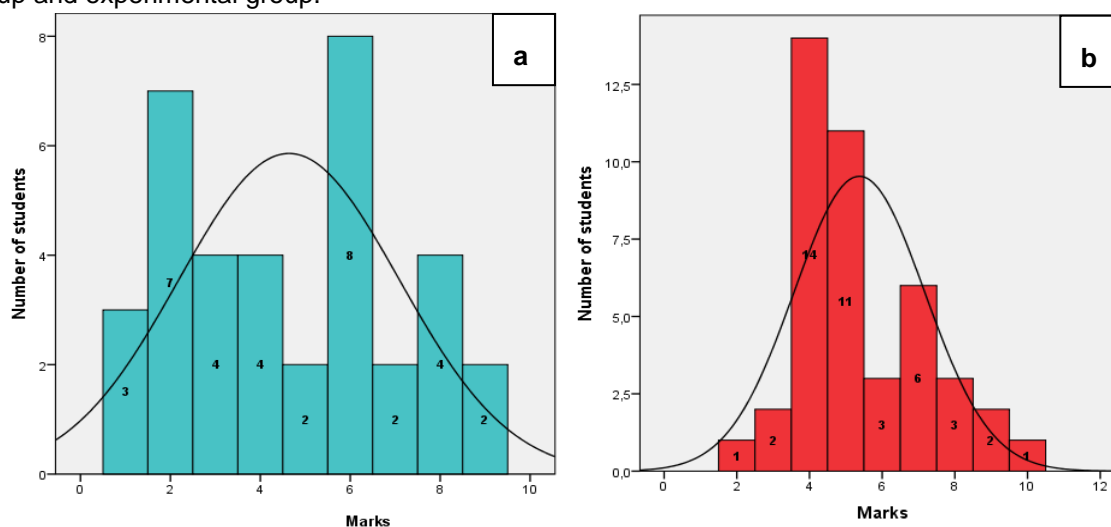


Figure 2. Students' number and marks for: a) Control group and b) Experimental group

In the box plot shown in figure 3, we see the comparative analysis of the distribution of the marks obtained by the control group and experimental group. We observe that with the use of the rubrics the students get better results, in general.

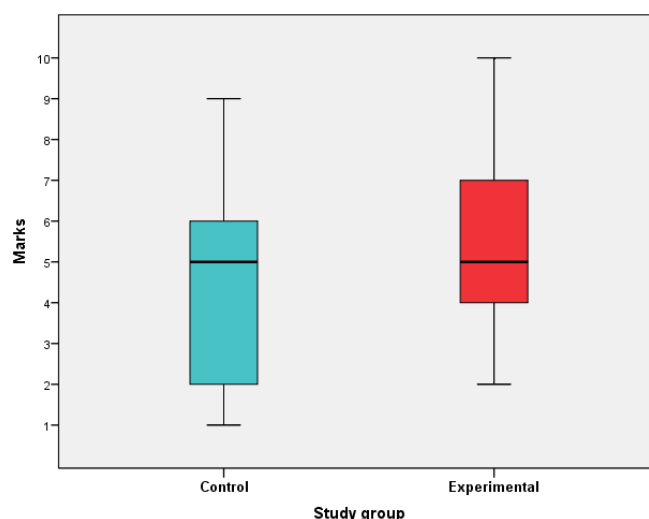


Figure 3. Comparative analysis between the two groups: Control and Experimental group

In table 2, we show the average of the results obtained for each item of the survey applied to the students, whose purpose was to know their perception of the use of rubrics in the development of a physics laboratory practice. In this same table, the average data obtained in each item of the perception survey applied to professors are presented. The applied survey is in Annex 1 and Annex 2. The

evaluation scale for each item, both for the survey applied to students and to professors was: 1) totally disagree, 2) partially disagree, 3) impartial, 4) partly agree and 5) totally agree.

Table 2. Descriptive analysis of marks.

	Item 1	Item 2	Item 3	Item 4	Item 5
Mean of student's answers	3.2	3.0	3.3	2.8	3.3
Mean of professor's answers	5	5	4	5	4

In figures 4, 5, 6, 7 and 8, we illustrate the results obtained for each statement raised in the perception survey on the use of rubrics applied to students

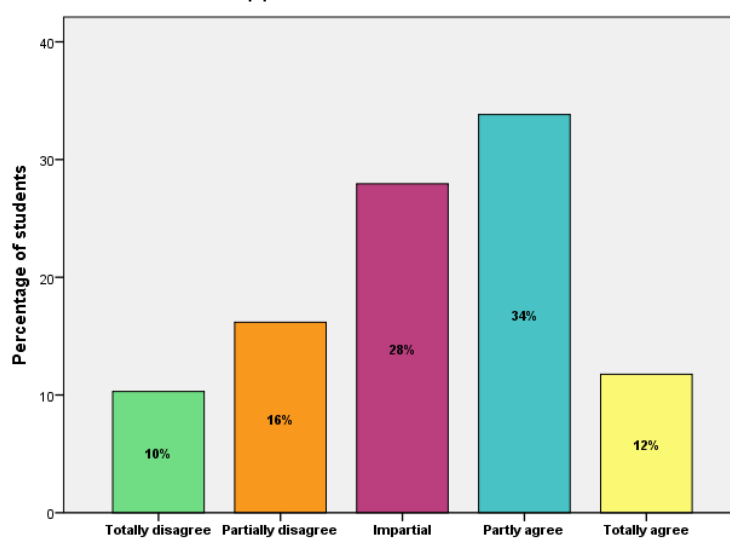


Figure 4. Item 1: Sometimes I have heard about evaluation by competences.

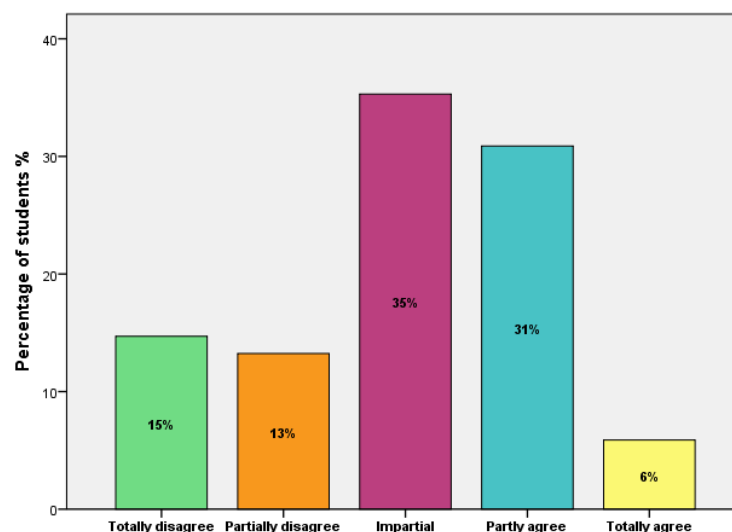


Figure 5. Item 2: I have previously used the evaluation rubrics

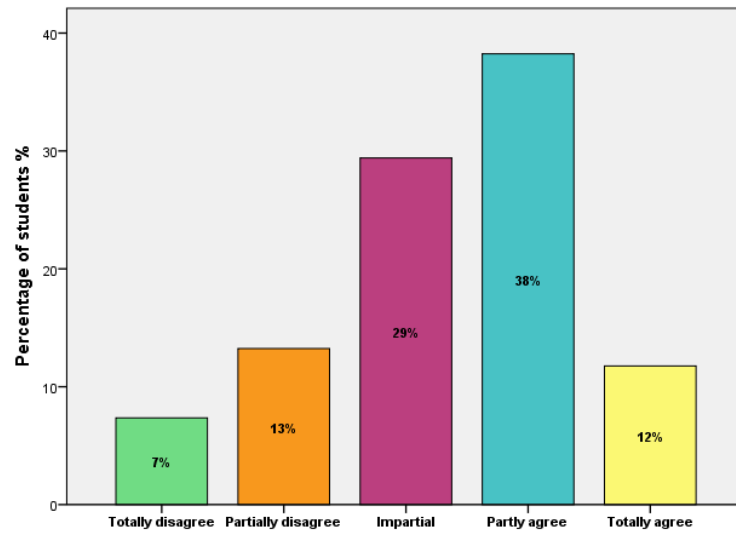


Figure 6. Item 3: *I believe that the use of rubrics facilitates the development of physics laboratory practices*

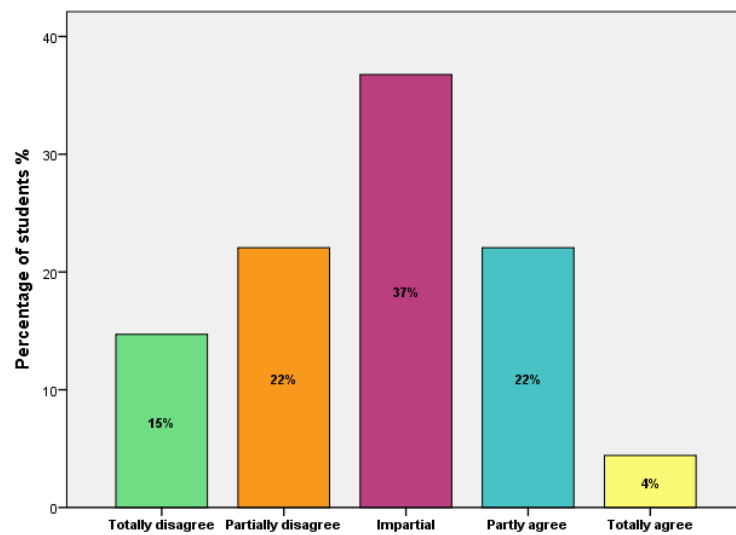


Figure 7. Item 4: *I learn better with this kind of evaluation, therefore my marks have increased*

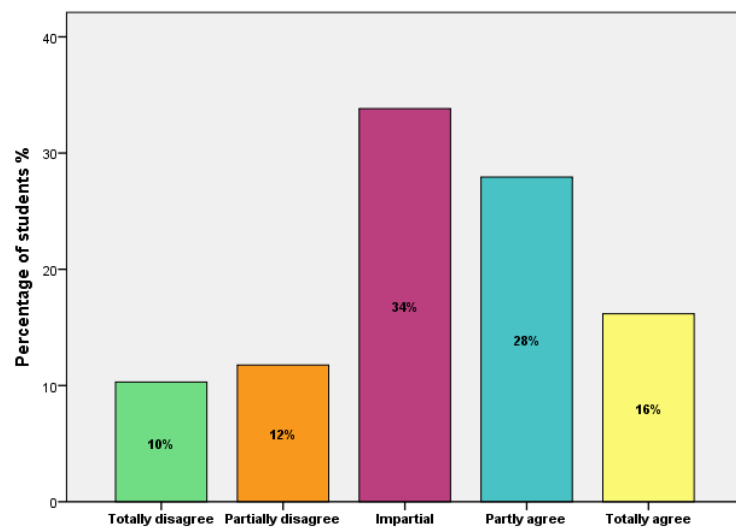


Figure 8. Item 5: *I like the evaluation with rubrics and I recommend it to other subjects*

In figures 9, 10, 11, 12 y 13, we illustrate the results obtained for each statement raised in the perception survey on the use of rubrics applied to professors

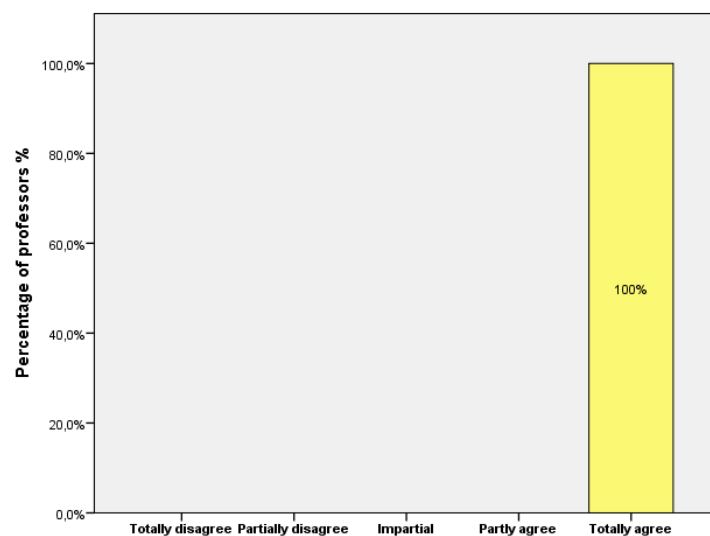


Figure 9. Item 1: Sometimes I have heard about evaluation by competences.

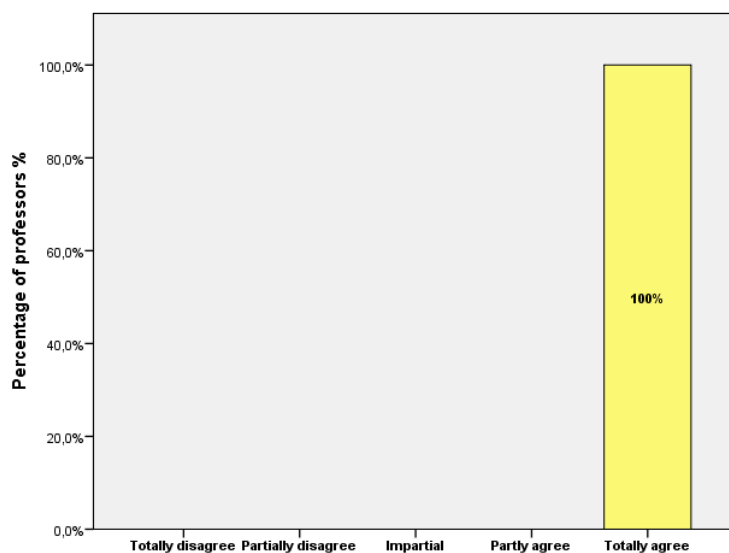


Figure 10. Item 2: I have previously used the evaluation rubrics

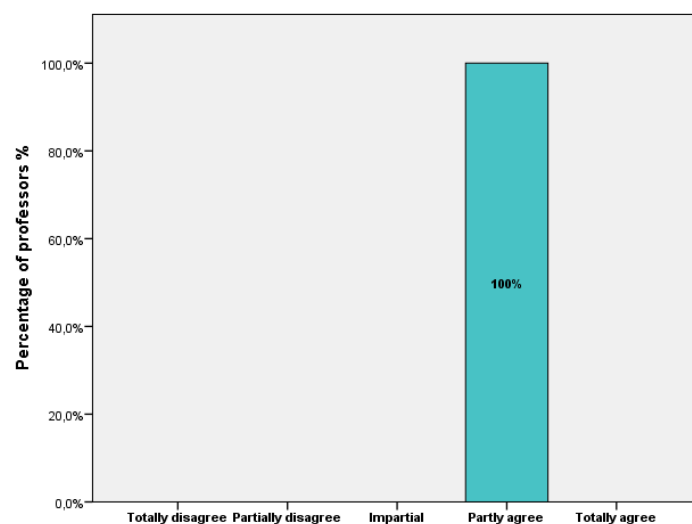


Figure 11. Item 3: I believe that the use of rubrics facilitates the correction of physics laboratory practice

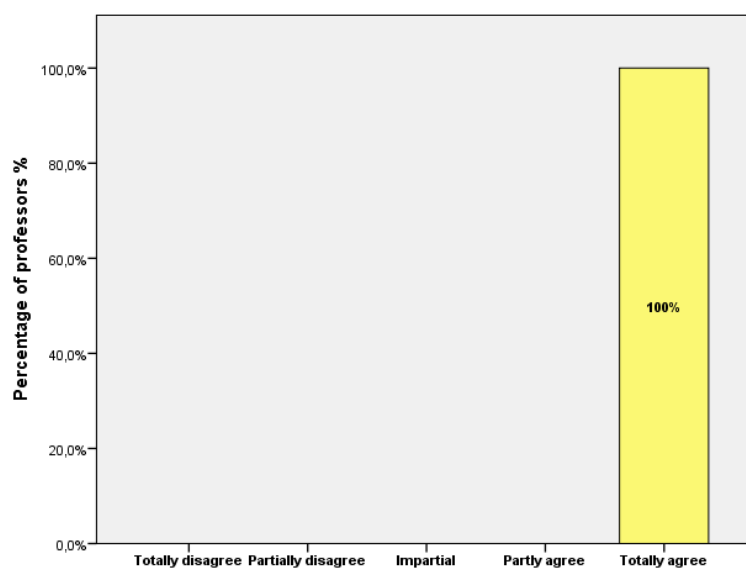


Figure 12. Item 4: With the use of rubrics the assignment of marks is more objective

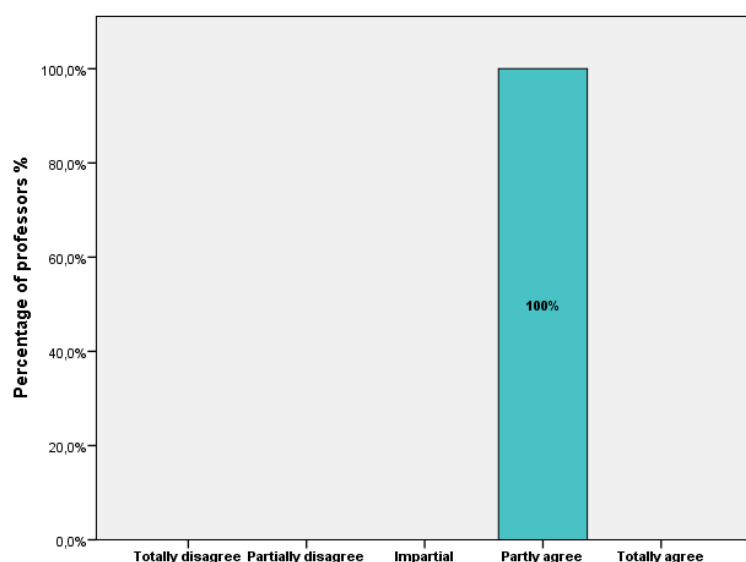


Figure 13. Item 5: I like the evaluation with rubrics and I recommend it to other physics professors

4 CONCLUSIONS

With the development and implementation of this evaluation rubric by competences for students of Physics for Computer Science Engineering of the Faculty of Computer Science Engineering at the University of Castilla -La Mancha (UCLM), Campus of Albacete, Spain, it has been identified that the use of this assessment instrument increases the students' marks. On the other hand, students think that it has been useful because it clearly specifies the activities to be carried out, facilitating their learning.

The professors responsible for the subject consider that it is a useful instrument, which facilitates the correction of the practices. In addition, they believe that it is a more objective instrument of evaluation. This is the first time this instrument has been used, we have identified it is as useful as beneficial for students and professors. Therefore, we will continue working on the development and implementation of other rubrics of physics laboratory practices.

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